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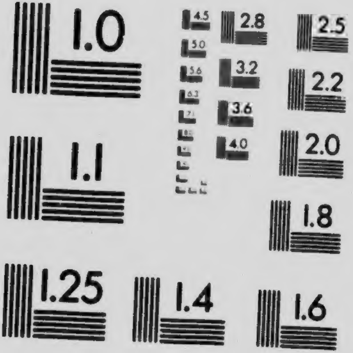

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GEOLOGICAL SURVEY

MEMOIR 97

NO. 79, GEOLOGICAL SERIES

Scroggie, Barker, Thistle, and Kirkman Creeks, Yukon Territory

BY

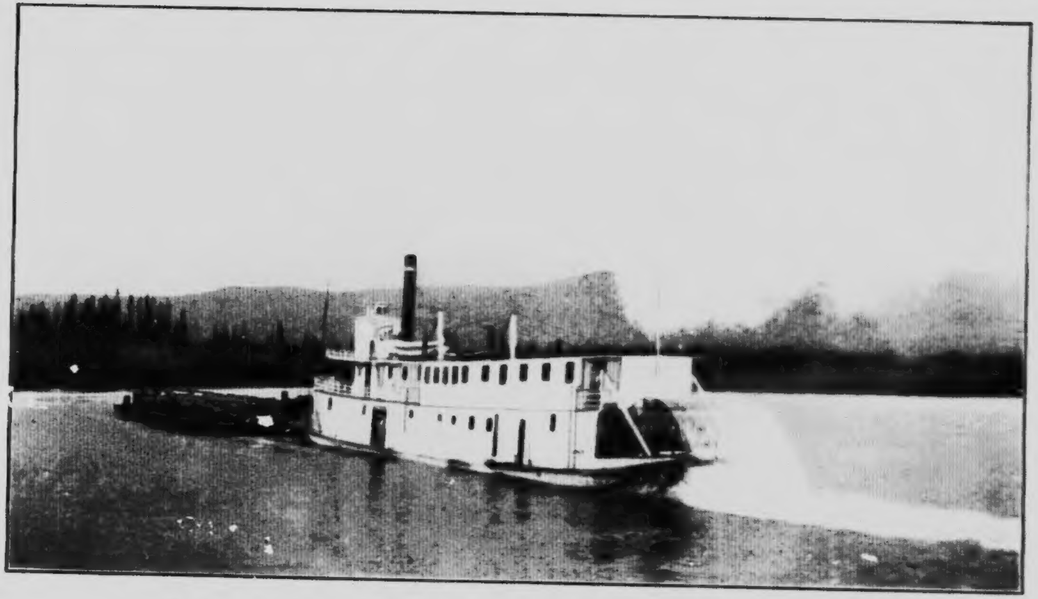
D. D. Cairnes

1842

OTTAWA
GOVERNMENT PRINTING BUREAU
1917

No. 1664

PLATE I.



Freight and passenger steamer *Vidette* on Stewart river near Mayo.

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Scroggie, Barker, Thistle, and Kirkman Creeks, Yukon Territory.

INTRODUCTION.

During the latter part of the year 1898, a number of creeks joining Stewart and Yukon rivers near their point of confluence were stampeded and staked. Most of these creeks lie to the east of the Yukon, and they extend up Stewart river about 45 miles. Since the staking there has been more or less placer mining along the various streams throughout this portion of Yukon Territory, and quite an important amount of gold has been obtained. Very little information has been available, however, concerning the geological conditions or mining operations throughout most of this region. Of the area adjoining Stewart and Yukon rivers and lying to the south of the Stewart, possibly less even was known than of the remaining portions of this general district. Accordingly, at the close of the field season of 1915, the writer spent ten days examining Scroggie, Barker, Thistle, and Kirkman creeks, which are the only four creeks in this locality on which any actual mining is known to have been done (Figure 1). These creeks were all discovered[1] in 1898, and since that time they have yielded between $200,000 and $300,000 in placer gold. When visited in September, 1915, about seventy men were actually engaged in placer mining on these streams, and during the winter months one hundred or more are employed, the greater number in winter being due to the fact that the creek gravels can in most places be worked by drifting. This method is one which may be pursued to advantage during the winter months, when very little other work is available in Yukon, and when prospecting and practically all other forms of placer mining are impossible.

Owing to the short time that was available, the examination of the creeks must be regarded as of only a preliminary nature. During the course of the investigation, the writer was accorded every possible assistance by all persons met on the various creeks, and he wishes to express his appreciation and gratitude for the many courtesies and kindly cooperation everywhere extended to him.

---

[1] In Yukon, when gold is found on a creek, and a Discovery claim is staked, the creek is said to be "discovered." This usually results in the creek being stampeded and staked practically from end to end

R. G. McConnell visited Thistle creek in 1901, and briefly described the conditions prevailing[1] there at that time, when, however, very little mining had been done. This short description comprises all the authentic published information that was available concerning the geological conditions and mining possibilities along these creeks, and throughout the general district in which they occur, previous to the writer's visit. A

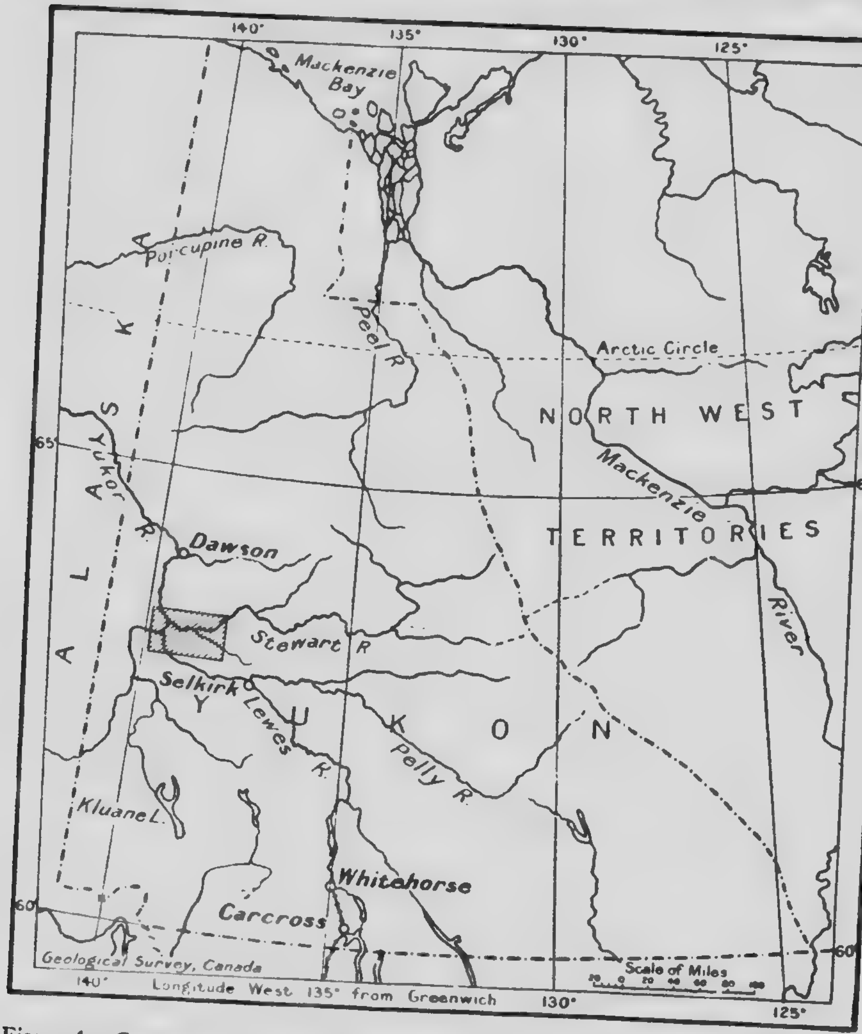

Figure 1. Geographical position of the area including Scroggie, Barker, Thistle, and Kirkman creeks.

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[1] McConnell, R. G., "Thistle creek," Geol. Surv., Can., Ann. Rept., vol. XIV, 1901, pp. 31A, 32A.

certain amount of information was available, however, concerning the valleys of Stewart and Yukon rivers, in the vicinity of these creeks. During the summer of 1900, McConnell came down the Stewart from Fraser falls to the mouth of the river, and made a geological reconnaissance *en route*,[1] and in 1888, he made a reconnaissance of the Yukon from Fort Yukon to Fort Selkirk.[2] This work has since been in part supplemented by the writer.[3]

ACCESSIBILITY.

These creeks are quite accessible, since they all empty into either Yukon river, or Stewart river near its mouth. Kirkman and Thistle creeks join the Yukon, and during the season of open navigation, large Yukon river steamers plying between Whitehorse and Dawson pass their mouths several times a week. The steamer *Vidette* also makes regular trips from Dawson up Stewart river to Mayo about every ten days during the summer months, and calls at the mouths of Barker and Scroggie creeks. The *Vidette* is a typical sidestreams boat, not as large as the regular Yukon river steamers, but commodious and comfortable (Plate I).

Roads and trails have been constructed along these creeks from the rivers into which they empty. The main Dawson-Whitehorse wagon road extends up Scroggie creek from its mouth to the forks of the creek, a distance measured along the road of between 11 and 12 miles; thence the road continues up Walhalla creek or the Left fork of Scroggie creek, as it is sometimes called, practically to its head. A branch road extends from the forks, up the Right fork or main Scroggie, to Mariposa creek, a distance of approximately 12 miles, follows Mariposa about 2 miles, and continues as a trail to near its head.

A wagon road follows along the bank of Stewart river from Scroggie to Barker creek, a distance of 2 miles, and continues up Barker to near Dixie creek, a farther distance of about 8 miles. Thence a trail follows up the creek bottom to Rush creek, and continues up Rush creek, and over the divide to Thistle creek.

A wagon road also follows up Thistle creek from the Yukon, about 15 miles, and thence a trail continues upstream and connects with Barker creek. A branch trail extends up Blueberry creek a distance of between 2 and 3 miles.

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[1] McConnell, R. G., "Stewart river," Geol. Surv., Can., Sum. Rept., vol. XIII, 1900, pp. 39A–43A.

[2] McConnell, R. G., "Report on an exploration in the Yukon and Mackenzie basins, N.W.T.," Geol. and Nat. Hist. Surv., Can., Ann. Rept., vol. IV, 1888–89, pp. 141D–145D.

[3] Cairnes, D.D., "Excursions in northern British Columbia and Yukon Territory," Geol. Surv., Can., Twelfth Inter. Geol. Cong., Guide Book No. 10, 1913, pp. 91–93.

A wagon road has recently been constructed up Kirkman creek, a distance of about 7 miles; thence a trail continues to near the head of the creek.

Thus practically all portions of these creeks may be reached from Stewart or Yukon rivers by road or trail. Very little freight is hauled up these creeks during the summer months, however, as the roads in places are too soft for heavy loads, and freighting over the snow is much cheaper. Supplies or outfits may be sent by river steamer to the mouth of a creek, near the close of the season of navigation, and freighted to the desired point when sleighing commences.

During the winter months the cost of getting freight from Dawson to Mariposa creek is about 4 cents per pound. A similar rate prevails for the upper portions of Barker creek. The rate to the mouths of Kirkman and Thistle creeks is somewhat less than to creeks entering the Stewart, and consequently miners on Thistle and Kirkman creeks can, as a rule, obtain supplies and outfits for less than those living on Barker or Scroggie.

CLIMATE.

The climate throughout the area occupied by these creeks is similar to that of Dawson and "The Klondike" generally. The summer months are particularly delightful, as, on account of the northern latitude, there is almost continuous daylight during June and July, and for at least four months, typical warm summer weather is generally experienced. The winters are cold, as might be expected, since these creeks lie almost entirely north of latitude 63 degrees; but even the winter months are not so extreme as might be supposed. In fact, the climate of southern Yukon in general has been, and by many still is thought to be much more severe than it really is. As an example of lack of extreme severity, horses winter out safely in many localities, including portions of Upper White River district,[1] of Kluane district, and elsewhere, without artificial shelter, and without being fed, provided they are in fairly good condition when turned out in the autumn, and provided also that they are placed where fodder is plentiful. For several years past, numbers of horses in different localities have so wintered, and in most cases have been found in good condition in the spring.

The amount of precipitation in the vicinity of the creeks here being considered varies considerably from year to year, but is never heavy, and during some seasons is almost as light as that of semi-arid regions.

The rivers generally open early in May, but the ice remains on some of the lakes until June. Slack water stretches freeze over any time after the middle of October, but some seasons the rivers remain open until the early part of November. The steamer *Vidette* generally leaves Dawson on her first trip up Stewart river about May 20, and navigates on the Stewart until about the end of September; then gasoline launches continue on the river until well on in October. Low water in the autumn, rather than ice, usually brings steamboat navigation on the Stewart to a close.

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[1] Cairnes, D. D., "Upper White River district, Yukon," Geol. Surv., Can., Mem. 50, 1915, pp. 25-28.

As concerns mining operations, during the almost continuous daylight of the early summer work can be conducted by night almost as well as by day without the aid of artificial light. At least five months of each year are favourable for surface work, and for the necessary outside operations connected with lode and placer mining as well as allied industries. The gravels, sands, and other superficial deposits are everywhere perpetually frozen to bedrock, except along stream channels or in other exceptional places where the insulating moss and muck have been removed; the frost also extends to varying depths in the underlying bedrock. This frost condition, although somewhat detrimental to hydraulicking or any form of open-cut work, is on the whole very beneficial to placer miners, as it enables them to prospect and mine the creek gravels, especially where deep, much more cheaply than would otherwise be possible. Gravels in the valley bottoms that are not frozen to bedrock, unless very shallow, are extremely difficult to prospect, except by the use of drills which are not usually available to prospectors; because not only does the ground cave during sinking, but water generally comes in through the gravels so fast, particularly near bedrock, that the shafts become flooded, and further sinking is rendered impracticable. Where the gravels are frozen to bedrock, shafts can be sunk and the gravels prospected and mined by drifting along bedrock, without timbering being necessary, and without trouble from excess of water. Not only is this drifting an economical method of mining, especially where bedrock is deep, but it is one that can be used to advantage during the winter months; thus employment is furnished when other forms of placer mining are impossible, and when very little other work of any kind is available in Yukon. Hydraulicking, sluicing, and all washing operations connected with placer mining may be commenced some time in May, and conducted until about the end of September.

FOREST.

The forest growth of this area is nowhere heavy, and is generally quite sparse. Trees, however, grow on most of the valley floors, as well as in the draws and on the hillsides up to an average elevation of approximately 3,500 feet above sea-level. One-third to one-half of the district is forested, the northern and eastern slopes being better timbered than the southern and western hillsides. Only in the valley bottoms, however, and in occasional draws are trees found sufficiently large to be used in the construction of buildings and in connexion with mining operations, except as fuel (Plates II, III, IV, V, VI). The largest and best timber of the district occurs in the valley bottoms of Yukon and Stewart rivers where there are many groves in which the trees are tall and stand fairly close together (Plate I). Although timber is nowhere very plentiful, there is sufficient that is reasonably accessible to meet the ordinary requirements of the placer miner for a number of years to come.

The principal forest trees are white spruce (*Picea canadensis*), black spruce (*Picea mariana*), balsam poplar (*Populus balsamifera*), aspen poplar (*Populus tremuloides*), and northern canoe birch (*Betula resinifera* or *B. alaskana*). There are also, a number of shrubs, some of which in places attain the dimensions of trees; these include several species of willow, one or more of alder, and dwarf birch (*Betula glandulosa*).

The white spruce is the largest, most useful, and by far the most plentiful of the larger forest trees. It grows at all elevations up to timber line, but is most common on dry slopes and over well drained portions of the valley bottoms; the best groves generally occur in the valley flats and in depressions along the lower slopes of the ridges, where the trees are straight and well grown. The trunks do not generally measure more than 12 to 18 inches in diameter 3 feet from the ground, but exceptional trees measure up to 24 inches in diameter. The wood of the white spruce is strong and easily worked, and it is well suited to the usual needs of the miner and to purposes of construction generally. Black spruce occurs associated with the white spruce, mainly in peat bogs or other poorly drained portions of the valley bottoms, and on the lower hillsides, particularly those facing the north; but is not as large or as well grown as the white spruce. Aspen poplar and balsam poplar constitute a large portion of the forest growth both in the valleys and on the hillsides. The balsam poplar grows best along the alluvial flats of the main valleys, while the aspen extends higher up on the drier hillsides. Specimens were seen in all stages of growth from small shrubs to forest trees 8 to 10 inches in diameter, or even larger. Poplar makes good fuel if the wood is properly dried, but it is too soft and irregular in form to be of any use for constructional purposes. The northern canoe birch, which is nowhere very plentiful, seldom exceeds 8 to 10 inches in diameter, and is of value at present mainly as fuel. Willows are quite plentiful in the valleys but do not extend far above the level of the larger streams. The dwarf birch occurs chiefly in the higher valleys, and along the upper slopes near timber-line. The alder generally occurs associated with willows and birch, but in places along the mountain slopes it is found practically unassociated with other varieties of shrubbery. It extends to practically the upper shrub limit.

TOPOGRAPHY.

The portion of Yukon Territory between Stewart and Yukon rivers, which is here being considered, lies well within the Yukon Plateau physiographic province (Figure 2). The Yukon plateau extends from about latitude 59 degrees, in northern British Columbia, through Yukon and Alaska to Bering sea; it has also a width in Yukon of from 200 to 400 miles, stretching from the ranges of the Rocky Mountain system to the inner members of the Coastal system which fringes the Pacific ocean.

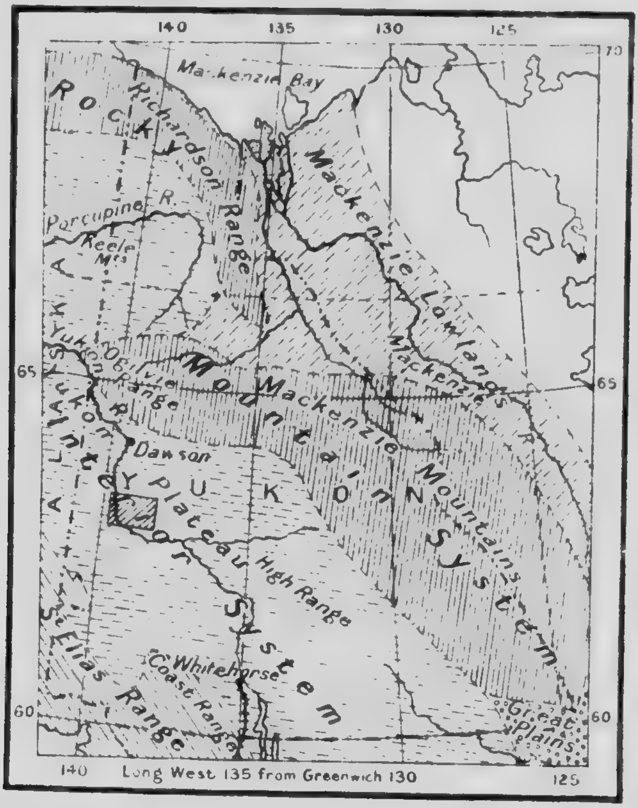

Figure 2. Physiographic map of Yukon Territory showing the topographic position of the area including Scroggie, Barker, Thistle, and Kirkman creeks. This area is indicated by the shaded rectangle.

Into the upland surface of this plateau province in Yukon Territory, the main drainage courses have incised their channels to depths in places of as much as 3,000 to 4,000 feet, thus producing a very irregular topography. The summits of the unreduced hills and ridges, lying between the various waterways, constitute remnants of what was once, apparently, a gently rolling plain. The surface of this plain bears no relation to rock structure, and is entirely discordant to the attitude, form, and configuration of the various sedimentary and igneous terranes, including the extensively developed and highly contorted, metamorphic members—erosion having equally bevelled and planated all rocks exposed, regardless of their hardness or other lithological characteristics. This plateau terrane where not too much dissected, and when viewed from a summit having an elevation corresponding to that of the general upland, impresses the observer with its even sky-line, sweeping off to the horizon, and broken only here and there by isolated, residuary masses rising above the general level.

The Yukon plateau has been studied by a number of geologists among whom there is a concensus of opinion that it represents a region which, during a long period of crustal stability, was extensively planated and reduced to a condition of relatively slight relief. The period of planation was followed by a widespread uplift, and the nearly flat or gently undulating lowland became an upland tract. This uplift rejuvenated the streams, giving them renewed head and consequent eroding power, with the result that they immediately commenced to rapidly incise and deepen their channels in the new upland. Thus a new physiographic cycle was inaugurated. There is some difference of opinion as to the exact date of this planation and subsequent uplift; but the bulk of the evidence goes to show that the Yukon plateau province was planated during pre-Pliocene, post-Eocene time, and that the planated tract was uplifted to nearly its present position during late Miocene, Pliocene, or early Pleistocene time.[1] The uplift or upwarp was apparently of a differential nature, the vertical movement being greatest along the margins and least along the middle of the region affected. The plateau thus acquired somewhat the form of a broad, shallow trough which pitches, in Yukon Territory, toward the northwest, the middle of the trough being occupied by Yukon river from which the upland rises gradually toward the mountains of the Coastal system on one side, and toward those of the Rocky Mountain system on the other.

The area particularly under consideration in this memoir thus occupies a position in the central portion of this great plateau province, and on the west, adjoins Yukon river which throughout its length holds a median position within this terrane. Near Yukon river the original upland has become almost entirely destroyed, and throughout practically the whole of the area between Stewart and Yukon rivers here being considered, the plateau has become maturely dissected, the only traces of the former upland being indicated by occasional straight-topped ridges. Between Kirkman and Thistle creeks the upland has a general elevation of slightly more than 4,000 feet above sea-level, although farther west toward the head of Scroggie it is somewhat higher, and occasional summits rise to between 4,500 and 5,000 feet.

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[1] Cairnes, D. D., "Wheaton district, Yukon Territory," Geo[illegible] .. Can., Mem. 31, 1912, pp. 83, 84.

The hills are characteristically well rounded and verdure clad (Plates II, III, IV). Bedrock is nearly everywhere obscured by the products of rock weathering and other superficial accumulations, although it is exposed on occasional small jagged summits, along valley walls, and at other points where slide, creep, or erosion processes have been particularly active. The valleys all have typical V-shaped cross-sections and interlocking spurs, and are in every way characteristic of depressions in an unglaciated region.

The climate has had a marked effect in the modelling of the land forms, and particularly in the shaping of the valleys. This effect is best shown on valley walls most exposed to the sun where, owing to alternate freezing and thawing, erosion as well as land sliding and creeping are much more extensive than on slopes facing the north and east, along Scroggie creek, for instance, and particularly between the forks and Stevens creek, land creep is progressing very rapidly, and has involved practically the entire mass of unconsolidated deposits on the east valley wall. The valley bottoms are flat, and covered with vegetation except along actual stream courses. The creeks are notably clear water streams; thus at present they are doing comparatively little work, a circumstance largely due to the frozen condition of the superficial deposits.

A marked feature in connexion with the valleys of the district is the terraces—one main terrace characterizing each creek. These possess grade nearly equal to that of the present streams. Along Scroggie creek, bedrock on the main terrace is in most places from 100 to 150 feet above the present stream level. To the south and west, the elevation of the terraces above their respective creeks decreases. On Barker creek, bedrock on the main terrace is from 85 to 100 feet above the present stream, and on Thistle creek it is nearly everywhere less than 70 feet. On Kirkman creek, the terrace occurs only along the lower portion of the stream, its top meeting the present creek bottom, and the terrace thus ceasing as such, at a point about 5 miles above the mouth of the stream. The terraces are overlain by creek gravels, and represent former, higher positions of the respective streams. Owing to a local uptilt of the land surface, or to some other cause producing a similar result, the streams have been quite recently rejuvenated, and, as a consequence, have rapidly incised their present channels down through these former floors. Owing to this rapid down-cutting, the present stream channels have in places quite abrupt rock walls rising to the elevations of the former stream positions, or to what now constitutes the terrace tops.

GENERAL GEOLOGY.

The geological formations exposed along Scroggie, Barker, Thistle, and Kirkman creeks, and throughout the general area in which they occur, include mainly old schistose rocks with which are associated certain gneissoid types, and also crystalline limestone. These are intruded by granitic and related pegmatitic rocks that are probably of Mesozoic age, and are in places quite extensively developed. The granitic rocks at certain points are highly garnetiferous, containing plentifully distributed, well formed garnets up to one-half inch in diameter. Dykes and small intrusive masses of more basic rocks, including andesites, diorites, and related types, also occur; they are probably of Carboniferous or Mesozoic age.

The older rocks include mainly mica schists, hornblende schists, chloritic schists, actinolite schists, cyanite schists, greenstone schists, schistose quartzites, schistose amphibolites, mica gneisses, hornblende gneisses, gneissoid quartzites, and crystalline limestone which is in places decidedly dolomitic. Several of the schistose types, particularly the mica and hornblende schists, pass by gradual transition into corresponding gneissoid varieties, and in some localities, mica and hornblende gneisses are the dominant rocks exposed. These schistose and gneissoid rocks are for the greater part of sedimentary derivation, but some of igneous origin also occur. They are all much folded, broken, contorted, and so intensely metamorphosed, however, that over considerable areas the two kinds are indistinguishable in the field. These rocks are very similar to the older schistose rocks of the Klondike[1] and other of the more important gold-producing districts of Yukon and Alaska; and all apparently belong to the Yukon group[2] the members of which are believed to be of Pre-Cambrian age.

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[1] McConnell, R. G., "Report on the Klondike gold fields," Geol. Surv., Can., Ann. Rep., vol. XIV, 1905, pt. B, pp. 11B–23B.

[2] Cairnes, D. D., "The Yukon-Alaska International Boundary, between Porcupine and Yukon rivers," Geol. Surv., Can., Mem. 67, 1914, pp. 38–44.

MINERAL RESOURCES.

GENERAL STATEMENT.

The placer gold occurring in the stream gravels is the only one of the known mineral resources of this area that is of any present economic importance. Lode deposits have been found in a number of localities, but only one of those known to have been so far discovered shows any promise of being of commercial value. This deposit occurs on the Black Fox mineral claim, which is situated near the head of Blueberry creek, a tributary of Thistle creek.

PLACER GOLD.

General Statement.

Scroggie, Barker, Thistle, and Kirkman creeks were all discovered during 1898, and placer mining has been in progress along these streams ever since, with the result that they have yielded up to the present between $200,000 and $300,000 in gold. Nearly all of this amount was obtained during the last 10 years, and the greater part of it within the last 5 or 6 years.

The gold occurs both in the present creek gravels along the valley bottoms, and in bench gravels on the terraces which are extensively developed along these streams. The terrace gravels, except along Thistle creek, have been little mined or even prospected, and on Thistle creek they have been mined or prospected at only a few points; while along Scroggie and Kirkman creeks they are practically unexplored. The gold appears, however, to be much more uniformly distributed in the terrace gravels than in the creek gravels. This is exactly what would be expected, as the creek gravels are, in most places, largely a reconcentrate from the older terrace gravels, as will be explained in the following section on "Gold-bearing Gravels." Thus, except along the upper portion of Kirkman creek, the gold is very erratically distributed throughout the creek gravels, and occurs mainly along portions of the creeks just below or opposite points where they have crossed or tapped the gold-bearing channels on the benches. On Kirkman creek, as before mentioned, the main terrace extends up the valley for a distance of only about 5 miles from the Yukon, and practically all the present mining operations are restricted to the 2 miles of creek bottom immediately above this point. There, the gold appears to be more uniformly distributed than throughout any other explored portion of these creek bottoms, due to the fact that the gold is largely or entirely an original instead of a secondary concentrate.

The gold on these creeks is high grade, assaying from about $17.90 to over $19 per ounce, including 4 to 6 cents in silver.

Gold-bearing Gravels.

The gold-bearing gravels along these creeks are of two types, as before mentioned: those in the valley bottoms which are here termed creek gravels, and those on the benches or terraces, called bench gravels. The creek gravels lie in the valley bottoms of the present creeks, and have been and still are being deposited by the creeks, thus their association with them both in position and origin is very apparent. Gravels corresponding to these creek gravels have been described in the summary report on Mayo area, under the term "present gravels" or "present creek gravels,"[1] to distinguish them from several other types of stream gravels which were produced during earlier periods and which lie at both higher and lower elevations than the valley bottoms of the present streams. Referring to the gravels in the valley bottoms of Scroggie, Barker, Thistle, and Kirkman creeks, however, the term "creek gravels" can be quite safely applied without misinterpretation or confusion, and is thus here adopted, as it is a more suggestive term than "present gravels," although no more correct.

All the gravels along these creeks are of local origin, since the area in which they occur has not been glaciated. Most of the pebbles and boulders have been derived from the schistose rocks of the area, and are dominantly flat or tabular in form. In places, however, pebbles and boulders of granitic and pegmatitic rocks, as well as of certain greenstones, occur, which are generally well rounded. The creek gravels, where they have been explored, are for the most part less than 10 feet in thickness, and in many places are only 3 to 6 feet. They are prevailingly overlain by a thin layer of muck which is from 2 to 10 feet in thickness, increasing toward the edge of the valley bottoms. The bench gravels are also shallow, being generally under 10 feet and rarely exceeding 15 feet in thickness. These are overlain by a layer of muck and included ice, which is usually shallow, but in places along Thistle creek is as much as 60 feet deep, and is believed to be even thicker nearer the valley walls.

The origin of the bench gravels and their gold content, as well as their relationship to the creek gravels and the gold they contain, present possibly the most important and interesting problems concerning the gravels of these creeks. The terraces upon which the bench gravels occur have grades nearly equal in places to those of the present streams, and are overlain by typical stream gravels. They are, therefore, stream and not lake features, and undoubtedly represent former higher positions of the present creeks. Also, since the terrace tops have less grade than the present streams, and constitute portions of former valley bottoms wider than the floors of the present stream channels, the gravels they originally supported, and still in part support, must represent a relatively long period of concentration, and should contain important amounts of placer gold. Due to some cause, the creeks that flowed in these now elevated valley bottoms, became suddenly rejuvenated, and began to rapidly sink their channels down through their former floors; and the deeper, more constricted stream channels of to-day were produced.

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[1] Cairnes, D. D., "Mayo area, Yukon Territory," Geol. Surv., Can., Sum. Rept. 1915, pp. 14-16.

The present creek gravels along the greater part of Scroggie, Barker, and Thistle creeks, as well as along the lower portions of Kirkman creek, are thus to a great extent a reconcentrate of the bench deposits, and the gold they contain is largely derived from the upper older gravels which have been concentrated by the present streams. The creek gravels are richest opposite sections where the benches with their overlying gravels are most completely washed down, as with the gravels the gold was carried down and redeposited along the present stream. Along certain portions of its course, a stream may hug one side or other of the valley for a considerable distance, leaving the bench almost unbroken. In such places the gold for the most part is still on the bench, and the gravels along the present creek contain very little gold, except opposite or just below occasional points where a slide or small tributary has tapped the gold-bearing bench gravels above. This is well exemplified at a number of points. For instance, along Scroggie creek the richest places that have been found are in the vicinity of the mouth of Stevens creek, where in each case the rich ground was found to occur opposite a deep cutting or excavation in the bench opposite. In working the creek gravels, it is advisable to search for such points. Most important of all, however, the bench gravels should be carefully prospected.

Kirkman creek possesses certain characteristics not seen in the other three creeks. It is a smaller stream than the others, and the height of the terrace above its mouth is less than in the case of the other three creeks, showing that at the time of rejuvenation of these streams, Kirkman creek was given least reinforced head. As a result of these two conditions, but mainly owing to its small size, Kirkman creek has only been able to sink its new channel through its former now uplifted floor for a distance up from its mouth of about 5 miles, to a point where the stream channel is exceptionally constricted, and is locally known as the canyon. This feature is gradually being extended upstream, and in time, remnants of the present valley bottom above the canyon, will appear as terraces on either wall of the creek. Above the canyon, the gold in the gravels is thus an original concentrate, and is not a reconcentrate or secondary concentrate from bench gravels. The distribution of the gold there thus decidedly more uniform than in the creek gravels on other stream being modified mainly by the character of the bedrock—whether this such as to catch and hold the gold, or let it readily pass over.

As to the cause of the sudden rejuvenation of these streams, th explanation that immediately suggests itself, is that of a local uplif or uptilt of the land surface, its maximum vertical movement in thi area being possibly about 200 feet. An uplift is supposed to have occurred in the Klondike district, which practically adjoins this area, and i generally believed to account for the relatively elevated position there o the high level creek gravels.[1] Furthermore, rock-cut benches generall overlain by stream gravels, follow along Yukon river from some poin above Kirkman creek, downstream past Klondike river to below Forty-mile river, and also extend up the various tributaries of the Yukon McConnell has well described these benches, his description including th following: "Well-marked rock-cut benches, usually supporting beds o gravel, occur along the Yukon and Klondike rivers, and extend for varying distances up most of the creeks. The principal rock bench has an elevation near Dawson of about 300 feet above the Yukon, or 1,500 feet above the sea, while smaller terraces and rolled gravels occur up to a height of 700 feet above the valley bottoms. The main terrace decreases in height ascending the Yukon and disappears near the mouth of the Stewart. It increases in height down stream as far as the mouth of Forty-mile river, where it has an elevation of about 700 feet above the valley-bottom."[2] This main terrace described by McConnell is the same that continues up the Yukon past the mouths of Stewart river, as well as Thistle and Kirkman creeks, and also extends up these streams. Thus it is quite clear that the rock-cut terraces along the Yukon in the vicinity of the Klondike, and elsewhere, and those in the area here being considered were produced at the same time and by the same agencies. The simplest theory and the one that has been generally accepted to account for the existence of all these terraces, as before mentioned, is that they were caused by a local uptilt of the land surface. It has been suggested, however, and it seems possible, that instead of representing an uplift, these terraces may be the result simply of drainage changes.

It is well known that quite recently the main drainage systems of Yukon and Alaska have suffered very extensive and fundamental changes. Large rivers have been forced to find new valleys which, in some cases, have led their waters even to other oceans; and the streams in some valleys have had their direction of flow reversed. These drainage changes are for the most part only very imperfectly understood, owing to the fact that much the greater part of Yukon Territory and Alaska are as yet largely unexplored. However, wherever any stream, owing to a change in the direction of the drainage or for any other cause, is suddenly afforded a lower outlet, or is turned into a valley that has a greater grade than the old valley, rapid channel cutting results and terraces appear—the remnants of the former valley bottoms constituting the terrace tops.

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[1] McConnell, R. G., "Report on the Klondike gold fields," Geol. Surv., Can., Ann. Rep. vol. XIV, 1905, pt. B, p. 31.

[2] *Idem*, p. 8B.

The Alaskan geologists have shown that a large stream formerly occupied a section of Yukon River valley below Fort Yukon, and drained in an opposite direction to that of the present river. This early stream followed up the valley of Porcupine river for some distance, and apparently reached the Arctic at a point lying somewhere between the mouth of the Mackenzie and meridian 141. Also the valley of Lewes river for some distance upstream from a point near Rink rapids is known to be much older than the valley for some distance below, now occupied by the lower portion of Lewes and the upper stretches of its parent stream, the Yukon; and the predecessor of this Lewes-Yukon of to-day, from a point near Rink rapids to at least well past the Klondike, formerly followed an old valley to the north of the present Yukon. This stream may have joined the other early river, just described, and have emptied into the Arctic as seems quite probable; or, as there is some reason to believe, it may have turned to the south and drained into Bering sea, possibly into Bristol bay. Recent explorations along the Arctic indicate that the Mackenzie lobe of the great Keewatin ice sheet extended along the Arctic coast to a point well past the mouth of the Mackenzie and possibly past meridian 141. This alone may have caused a diversion of Yukon drainage to its present lines. It is thus possible that the Yukon, when turned into its present course in the vicinity of Stewart and Klondike rivers, inherited a valley formerly occupied by a stream flowing in an opposite direction, as indicated by the terraces, the tops of which would in this case represent the valley bottoms of this stream and its tributaries at different times.

This drainage diversion theory or a similar one, may thus account for the rock terraces along this portion of Yukon river and its tributaries. However, the former drainage changes of this region are very imperfectly understood, and until more work of a regional as well as of a detailed nature is completed, no final conclusion can be reached. The generally accepted theory of an uplift or uptilt to explain the rock-cut terrace appears, however, to be quite feasible at present, but there is little or no proof of it except the presence of the terraces themselves, which, as has been shown, may possibly be due to other causes. It is immaterial to the placer miner, however, which theory may be correct, as the various stream channels, former and present, would be affected in practically an identical manner by either operation or set of agencies. The uptilt theory, being quite readily comprehendible, forms in any case a valuable working hypothesis for mining operations.

The rock-cut benches referred to here are not to be confused with certain gravel terraces along Yukon river and its tributaries, which are due to quite other causes.[1]

Methods of Working.

In the following descriptions of methods of working, no attempt is made to include all the theory and details of placer mining even as followed in this district. It is intended rather to give a general account of the different methods employed, and particularly to describe practices peculiar to this area, as a result largely of its geographical position, and of the somewhat exceptional climatic conditions prevailing.

The creek gravels are mined both by open-cut and drifting methods, and the bench deposits are hydraulicked. The choice of open-cutting or drifting in the case of the creek deposits depends on a number of factors. Owing to the snowfall and low temperatures prevailing during the winter months, the open-cut method cannot be satisfactorily adopted during that season. Instead, it is followed only in summer, and is particularly adapted to shallow deposits, as by this practice, all the materials overlying bedrock have to be moved. On the other hand the creek gravels are worked by drifting where bedrock is deep, and when the overlying deposits are frozen throughout. As this is practically the only method of placer mining that is feasible at this northern latitude during the winter months, it is then most extensively followed. As a result, on each of the creeks described in this memoir, there are more men employed in winter than in summer, as the drifting method in many places can be more advantageously employed; and, during the winter, there is very little other employment of any kind available in Yukon. The drifting method is particularly adapted to the working of thick or even moderately thick, frozen deposits in which the gold is very erratically distributed, or where the ground to be mined has been only slightly prospected and the distribution of the gold is, therefore, uncertain. By the open-cut system all the materials overlying bed-rock, that occur within the cut as outlined, have to be moved, and much valueless material may have to be handled to reach a relatively very small amount of pay gravel, particularly if the gold occurs in streaks, perhaps narrow or widely separated. When drifting, practically only the gold-bearing gravels need be mined, and all deposits between the pay-streaks, or overlying the gold-bearing gravels, are left.

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[1] Cairnes, D. D., "Wheaton district, Yukon Territory," Geol. Surv., Can., Mem. 31, 1912, pp. 21–23.

By the open-cut method, the pay gravel as well as all the valueless overburden are handled. The overburden is commonly removed by water or scraper. In some cases, an ordinary drain or ditch is trained over the surface, and thus the overburden is gradually washed away; where, however, sufficient head is available the water is applied by nozzle or monitor. Occasionally an empounding dam is constructed just above the ground to be mined, which may or may not work automatically. Such a dam is used mainly during the spring when water is most plentiful. The water collects behind the dam and as it reaches a certain level near the top, is released, and spills with great force and effect over the ground below. This, where it can be made feasible, is a very economical and rapid method of removing the overburden. Sometimes, also, a scraper operated either by horse-power or steam is employed. The underlying gravels, as well sometimes as the overburden, may be ground-sluiced or handled entirely by a nozzle, where water with sufficient head is available, or they may be loaded into barrows or buckets by pick and shovel. The barrows are wheeled to the sluice boxes and dumped; or if buckets are used, these are conveyed by cable to the sluice boxes and there automatically unloaded, the motive power generally being steam. This installation of bucket or scraper, conveyed by cable either to the sluice boxes or directly to the dump, and there automatically unloaded, is termed a self-dumping equipment. The thawing by the open-cut method is done by the sun. As the frost disappears from a face or surface of the workings, the thawed materials are removed. The creek is diverted from the workings, generally by ditch or flume; in addition, a bedrock drain which is usually covered, has to be constructed to drain into the creek below, the water that accumulates in the open-cut.

In drifting operations a shaft is sunk to bedrock, and the gold-bearing gravels as well as a certain amount of bedrock are mined and hoisted by the shaft to the surface. This method of work cannot as a rule be followed unless the superficial deposits are frozen completely to bedrock, since, if thawed strata are pierced, water generally comes in much faster than it can be pumped out, and the works have to be abandoned. Little or no timbering is required except possibly around the shaft; its use, if necessary, would add greatly to the cost of working. The roof generally holds up remarkably well, but it is usually more or less supported by waste gravel, boulders piled behind the working face, and pillars of the gravels. The underground workings are often very irregular, owing to the erratic distribution of the gold; but where the gold is fairly uniformly distributed, the workings resemble those of a coal mine where the seam is flat and is being mined by either the "long-wall" or "pillar-and-stall" system.

The underground thawing in this district is all done either by wood fires or steam points driven into the gravels; in other nearby localities hot water thrown against the frozen ground from a nozzle, has proved a very effective method of thawing.

The thawed material is picked down and shovelled into cars or barrows, and conveyed to the bottom of the shaft and hoisted. The hoisting is done either by a common windlass or by steam power. Where steam is used, a self-dumping equipment is installed, and the hoisted material is conveyed by cable to the unloading place and there automatically dumped. In places, especially on Scroggie and Mariposa creeks, what are termed one-man self-dumping equipments are installed. By this arrangement, a windlass is constructed at the bottom of the shaft, or in open-cut work at the bottom of the workings. The windlass is connected with a system of cables on the surface by which, as the windlass is turned, the bucket is hoisted to a cable at some elevation above the top of the shaft or workings, and then conveyed along it to the sluice boxes or dump and there is unloaded automatically. The empty bucket then comes back to the bottom of the shaft by gravity, its return being controlled by a brake attached to the windlass. With this equipment one man alone can drift his ground, doing all the work effectively. In summer the gravels, as they are hoisted, are dumped directly into sluice boxes and washed; in winter they are deposited near the top of the shaft, and are washed in the spring as soon as water is available.

In hydraulicking the bench gravels, all the unconsolidated deposits overlying bedrock are washed down by water delivered from nozzles or monitors, the water, to be effective, having considerable head. By this method the thawing is all done by the sun's heat. As the gravels and associated deposits exposed to the sun's rays on a working face become sufficiently thawed, they are washed down by streams of water delivered from the monitors or nozzles. They are then all washed into the sluice boxes below, except the large boulders which are generally piled on the bench. Then the water is turned on another thawed face, while the former is again left exposed to the sun. The sluice boxes have necessarily to be set down in the bedrock, and so arranged as to have sufficient grade to readily carry away all the materials turned into them, and deposit them at some point below, where there is tailings room.

Many modifications of these three main methods are practised, nevertheless, the general principles involved are practically everywhere the same. On one property, for instance, the owner, where open-cutting and working alone, was using a unique modification of the one-man self-dumping equipment. A windlass was installed in the bottom of the cut, and by means of this a car was pulled up skids and dumped automatically into sluice boxes at the top of the cut. The car then returned to the bottom of the cut by gravity, being controlled in so doing by a brake attached to the windlass. Numerous other ingenious contrivances of like order were noted at different points.

For hydraulicking the bench deposits, efficient equipment has been installed at several points, but for working the creek gravels, only primitive hand methods are employed practically everywhere along Scroggie, Barker, Thistle, and Kirkman creeks, a steam-propelled, self-dumping equipment, even, having been installed on only one property. With larger and better plants, much greater economy could be effected in many places, and creek gravels could be mined at a considerable profit that with present methods yield less than wages. Wherever feasible, the use of a properly installed, steam propelled, self-dumping equipment, greatly reduces the costs of working as compared with hand labour, and seems to be the installation best adapted at present to the working of these creek gravels.

Scroggie Creek and Its Tributary Mariposa Creek.

General Description. Scroggie creek flows in a general westerly to northwesterly direction, and joins Stewart river about 25 miles above its confluence with the Yukon. The main stream valley is about 40 miles in length; the creek is thus one of the most important, topographically, in this portion of Yukon, and is considerably larger than Barker, Thistle, or Kirkman creeks. Mariposa creek is 6 or 7 miles in length, follows a general course almost due west, and joins Scroggie creek on its right limit (side) 19 miles above its mouth, measured along the valley bottom, or about 4 miles farther by the wagon road.

Gold was found on Scroggie creek as early as 1898, Discovery claim being located on August 27 of that year by Messrs. J. G. Stephens and H. le Duke who located the upper and lower halves respectively. On the same date, claims No. 1 and No. 2 above Discovery were respectively staked by Ernest B. and W. T. Scroggie after whom the creek is named. On October 23, 1900, a concession known as the Scroggie concession was granted to Ernest B. Scroggie. This concession is described as follows: "All and singular that certain parcel or tract of land lying and being in the Yukon Territory, on Scroggie creek, a tributary of the Stewart river, commencing at a point 2½ miles above Discovery on Scroggie creek, thence downstream five miles, in width from summit to summit on either side of the creek."[1] Some mining was done on this property, but the gold obtained, according to an estimate by Mr. George P. MacKenzie, gold commissioner of Yukon Territory, did not probably exceed two or three thousand dollars. The concession was cancelled on April 30, 1906; after that quite a number of claims were staked along this portion of Scroggie creek. Only a very limited amount of prospecting and mining followed, however, until 1911, when Messrs. Halvor Ness and A. Routhier with three partners, Messrs. Lee, Taylor, and McKay, who have since left the creek, found gold in important amounts on No. 16 above Discovery. This resulted in the creek being stampeded, and ever since that time there has been more or less placer mining along it, and each year has witnessed an important gold production. When visited during the summer of 1915, about twenty men were engaged in placer mining along Scroggie and its tributary Mariposa creek, and during the winter months, an average of from forty to fifty men are reported to be there.

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[1] From the records in the Gold Commissioner's Office, Dawson, Yukon Territory.

The rocks exposed along Scroggie creek and its tributary Mariposa include mainly schistose and gneissoid types, chiefly mica schists, mica gneisses, quartzite schists, gneissoid quartzites, and cyanite schist, which are all, dominantly at least, of sedimentary origin. Granitic and pegmatitic rocks also occur, and in places are quite extensively developed. The granitic members are locally quite highly garnetiferous and contain well formed garnets up to one-half or three-fourths of an inch in diameter. Occasional dykes and other small intrusive masses of semi-basic to basic rocks also occur, including mainly andesites, diorites, diabases, and related types. The gravels for the most part originated from these schistose and gneissoid rocks, and the pebbles are consequently flat or tabular in form. Well rounded, granitic, pegmatitic, and greenstone pebbles and boulders, however, also occur. Due to the high specific gravity of cyanite and garnets, the pebbles of cyanite schist and of the garnetiferous granitic rocks are exceptionally heavy. They thus collect with the concentrates and occur in the heavy gravels carrying gold; on this account, especially along Mariposa creek, they are regarded by the miners as gold indicators.

The main terrace or bench following Scroggie creek is quite prominent along the greater part of its valley; and is particularly well preserved between Stevens creek and Walhalla creek, or the forks of Scroggie as the mouth of Walhalla creek is generally termed. There it is confined almost entirely to the left or west side of the valley, its top being about 100 to 125 feet above the level of Scroggie creek. Below the forks, the valley flat widens, becoming in places one-half mile or more in width, and the main terrace becomes gradually slightly higher, and, at the same time, is less well preserved. Between Stevens and Mariposa creeks this terrace is about 100 feet above the valley bottom and is prevailingly on the right side (limit) of the valley, although some remnants occur on the left side. This terrace also extends up Mariposa creek some distance, being best preserved on the right (north) side of the valley, the valley flat along the lower portion of Mariposa creek being generally from 200 to 500 feet in width.

Prospecting and mining along Scroggie creek and its tributaries have been almost entirely restricted to the valley of the main stream between the forks and Mariposa creek, to Mariposa creek, and the lower portion of Stevens creek near Scroggie. A few prospect holes have also been sunk in the valley bottom of Scroggie creek for some 3 or 4 miles below the forks; there bedrock is reported to be about 20 feet below the surface. Also, some prospecting has been done up Walhalla creek, as the left fork of Scroggie is generally called.

The mining operations have been confined to the creek gravels, the bench deposits being as yet practically unexplored. The creek gravels, so far as is known, are comparatively shallow and are in most places overlain by a thin deposit of muck. During the winter months they are frozen down to bedrock, except possibly under or near the stream channel; but throughout the summer they are frozen to bedrock only in certain places. Wherever the insulating moss and muck have been removed they readily thaw under the summer sun. In many places water appears to circulate near bedrock through unfrozen deposits. The gravels are mined either by open-cutting in summer, or by drifting either in summer or winter; but drifting can be performed in summer only in places where the frost extends to bedrock.

The distribution of the gold is very erratic, being dependent not only on the retaining or holding character of the bedrock, but on the bench deposits above. Each of the places where important amounts of gold have been found are opposite or just below a small tributary or slide from the bench, indicating that the gold in the present creek gravels must have been to a great extent derived from the bench gravels. The gold occurs nearly always on or in the bedrock, 1 to 3 feet of which is generally taken up in mining operations. The gold is, as a rule, quite coarse and chunky, and assays from $18.60 to $19.10 an ounce, including about 4 cents in silver. The total amount of gold that has been produced from Scroggie creek and its tributaries is generally estimated at between $50,000 and $75,000, but some authorities claim it to be nearer $100,000.

Mining Operations on Scroggie Creek. The lowest point on Scroggie creek where any mining was being performed during September, 1915, was on No. 9C above Discovery—Discovery claim being about 1½ miles below the mouth of Stevens creek. During the winter months, however, a few men are generally engaged in drifting at various points between No. 9C and the forks of Scroggie. On claim No. 9C the owners during the summer of 1915 were engaged in drifting operations, the depth to bedrock on this ground being generally from 10 to 18 feet. The shaft then being used passed through 6 to 9 feet of muck and 4 to 5 feet of underlying gold-bearing gravel which is quite coarse, and contains numerous boulders from 20 to 36 inches long. The so-called bedrock underlying the gravel is compact, considerably decomposed, slide material, and not rock in place. In fact, in this vicinity sliding and creeping activities along the valley walls are so active as to cause considerable amounts of irregular, unsorted materials to accumulate in the valley bottoms. Thus the gold is more erratically distributed than in most places, and occasionally is not on bedrock at all, but several feet above it.

The next property, upstream, being worked, was No. 14 above Discovery, part of which has proved to be exceptionally rich. This claim has been worked mainly by drifting, but some open-cutting has also been done.

The ground next above No. 14 is held by Halvor Ness and A. Routhier, who own Nos. 15, 16, 17, 18, 19, and 20, above Discovery, as well as Discovery claim on Stevens creek, which adjoins No. 15 above on Scroggie. Since they acquired this property in 1911, the owners have worked it practically continuously, summer and winter. On No. 15 the gravel is generally from 6 to 8 feet thick and is overlain in places by a thin layer of muck. On Nos. 16 and 17 the depth to bedrock, in most places, is between 6 and 8 feet. and on No. 19 it is 12 to 14 feet. During the first year this property was worked, about $6,000 in gold is believed to have been obtained, the total yield to September, 1915, being about $20,000. The gold is practically all on or in bedrock, 1 to 3 feet of which is taken up in places. The gold itself is very coarse, occurring mainly as nuggets of $1 to $5 value, very little being in pieces worth less than 25 cents.

On Nos. 22 and 22, o, a, above Discovery, respectively, the owners were engaged in open-cutting. No. 24 above Discovery was being drifted, the shaft in use when visited in the autumn of 1915 having passed through 6 feet of muck and 9 feet of gravel and sand, before reaching bedrock. The gold there, as elsewhere along this portion of Scroggie creek, is very irregularly distributed, and is represented as occurring in small, irregular channels, erratically distributed across the valley bottom. This claim, which is a short distance below the mouth of Mariposa creek, is the highest point on Scroggie creek, at which any work was being performed.

Mining Operations on Mariposa Creek. On Mariposa creek, which joins Scroggie on No. 28 above Discovery, a number of claims were being worked; the drifting method was mainly employed, but along the upper part of the creek, some open-cutting was also being done. From the mouth of the creek up to about Discovery, the depth to bedrock is about 12 or 18 feet, but above No. 35 above Discovery, the depth is said to increase to 29 or 30 feet. Discovery claim on Mariposa is at the mouth of the creek. On No. 9 the largest nugget that has been found on Mariposa creek was taken in August, 1915; this was valued at $85.

Barker Creek.

General Description. Barker creek has a general course of almost due north, and joins Stewart river on its left or south bank, 2 miles below the mouth of Scroggie creek, or 23 miles from the Yukon. The valley of the main stream has a length of about 15 miles.

Barker creek was named after F. M. Barker who located the lower half of Discovery on November 8, 1898. The creek was then stampeded, and staked practically from end to end. By June, 1899, however, Barker creek was deserted, only a few having remained throughout the winter to clean up their dumps in the spring. In 1902 a couple of men did a little work along the stream, and in 1903 Louis Mart staked a new Discovery which is the present Discovery claim, and is located about 9 miles from the mouth of the creek. During practically all of 1903 and 1904 Mr. Mart was alone on the creek, but in 1905 he was joined by four or five men from Thistle creek, who staked claims adjoining his ground. During the summer of 1905 a number of people coming down Yukon river stopped off at Stewart, and went over to Barker creek and staked. That autumn and winter the creek was again stampeded, and the main valley as well as its tributaries were staked. Most of these stakers again soon left the creek; but a few remained and during 1908, a coloured man named Jos. Butler found coarse gold in the bench on No. 19 below Discovery. This caused another and the last stampede that has occurred on Barker creek. Many of these stampeders also gradually left; the few remaining take out, each year, a certain amount of placer gold. When visited during September, 1915, seven men were actually engaged in mining on Barker creek.

The rocks exposed along Barker creek are chiefly the old schistose and gneissoid members including mainly mica schist, hornblende schist, schistose quartzite, mica gneiss, hornblende gneiss, and schistose amphibolite, the hornblende varieties being very prominent particularly along the upper portion of the creek. With these rocks are associated some old crystalline limestones which are in places dolomitic. These older rocks are all locally, and in places quite extensively intruded by granitic and pegmatitic rocks, as well as by certain greenstone rocks, all of which are probably of Carboniferous or Mesozoic age. The gravels, being of local origin, are mostly derived from the schistose and gneissoid rocks, and, accordingly, the pebbles and boulders composing them are for the greater part flat or tabular in form. Some well rounded granitic, pegmatitic, and greenstone members also occur, however, both in the creek and bench gravels.

The main terrace along Barker creek is very pronounced: it extends from the mouth practically to the head of the stream, and continues up the valleys of its tributaries. It occurs prevailingly along the left or west side of the main valley, and in places persists for several miles almost without a break, excepting occasional narrow incisions made by tributary streams crossing it to join the main creek. Near the Stewart, the top of the terrace is 125 to 150 feet above the creek level, but the grade of the terrace being less than that of the present valley bottom, the two surfaces come gradually nearer together as the head of the creek is approached, so that just below the mouth of McRae creek, bedrock along the outer edge of the bench is only 85 to 90 feet above the creek level. The bench has an average width in most places of about 500 feet, and its surface slopes toward the creek, dipping in most places about 65 to 70 feet in the outer 400 feet, back of which the top of the terrace rises somewhat abruptly to meet the general valley slope. The surface of the bedrock underlying the superficial deposits forming the top of the bench, instead of having a uniform slope down to the lower edge facing the creek, in most places where exposed, comes down in a series of broad shallow steps.

Both bench and creek gravels along Barker creek have been worked, but the bulk of the gold has come from the benches. The creek gravels have been prospected and mined at a number of points, mainly by sinking, and in places by drifting as well. The bench gravels have been mined at only two points. Near the head of the creek, Dr. C. N. Graham has hydraulicked a strip of bench about 500 feet long; and, about 5 miles lower down the stream and just below Dixie creek, the bench gravels on three adjoining claims have been mined to quite an extent. Both creek and bench deposits are in most places, at least, quite shallow.

The gold in the creek gravels on Barker creek, as along Scroggie, is very unevenly distributed, and in the few places where it has been found in important amounts, mainly on Discovery claim and on Nos. 31 and 34 below Discovery, the indications point to the gold being largely at least a direct concentrate from the bench deposits. Altogether, gold to the value of probably about $5,000 has been obtained from the creek gravels along this stream. In the bench gravels the gold appears to be somewhat more uniformly distributed, although these have been only explored at two points as before mentioned. In all it is estimated that Barker creek has yielded placer gold to the value of between $25,000 and $30,000. The gold itself is prevailingly coarse, particularly in the bench gravels where, for instance, on No. 19 below Discovery and on adjoining claims, nuggets worth $8 and $10 are of common occurrence, and relatively little gold is found in pieces worth less than 25 cents. Near the head of the creek the gold is quite rough, but is smoother lower down. It assays from $18.35 to $18.85 per ounce.

Mining Operations. When Barker creek was visited in September, 1915, the lowest point along the stream at which any work was being performed was on the property of W. H. Taylor who, in addition to some interests above No. 23 below Discovery, was holding about ten claims between No. 23 and No. 34 below Discovery. Mr. Taylor has been engaged in prospecting and mining on Barker creek since 1909, and during this time has devoted his energies almost exclusively to the creek gravels. During three winters he drifted in the creek bottom, but in so doing, according to his own statement, recovered only sufficient gold to pay a little more than expenses—not nearly enough to amount to wages. When visited, Mr. Taylor was sinking a prospecting shaft in the bench deposits on the left side of the creek, on claim No. 23 below Discovery. His shaft at the time was 30 feet deep, and bedrock had not yet been encountered.

On the upper half of claim No. 20, as well as on claim No. 19 below Discovery, the bench gravels were being hydraulicked. The gravel on these claims is in places as much as 8 feet in thickness, but is commonly only from 4 to 6 feet. The pay gravel or pay-streak is considered to be about 150 feet wide, and from No. 19 alone it is estimated that about $7,000 has been obtained. This is the richest ground yet found on Barker creek, the $7,000 having come from a strip of bench only 180 feet long, as a gulch joining Barker creek at this point has destroyed what was formerly the upper portion of the bench on this ground. The largest nugget yet found on Barker creek, was obtained on No. 19 and was valued at about $112. The conditions prevailing on Nos. 20 and 21 are very similar to those on No. 19. The water for the hydraulic operations on claims Nos. 19, 20, and 21, is furnished by a ditch 1½ miles long, which gets its supply from Dixie creek. On No. 18 below Discovery, hydraulic work had also been commenced.

Practically all the creek and bench deposits above these claims were owned, when visited, by Dr. C. N. Graham, who held about 5 miles of Barker creek between the mouths of Agate and Dixie creeks. Dr. Graham came to Barker in 1906, and has been ever since identified with this creek. He commenced mining operations on his arrival, and has since performed considerable work, mainly on claims Nos. 27 and 28 above Discovery. A ditch 6,000 feet long was constructed during 1907 and 1908, which takes water from McRae creek at a point just below where joined by Agate creek. This ditch was designed to carry 700 inches, but that much water is only available for a short period of the season. There is, however, believed to be rarely less than 200 inches. Some ground sluicing was done in 1907, and the first hydraulicking was performed near the close of the summer of 1908. Afterwards about 500 feet of the bench was stripped for an average width of about 100 feet, and from this cut $10,000 is believed to have been recovered (Plate II). No work other than the regulation representation work has recently been performed on this property.

The outer or lower edge of the bench where stripped, is 85 to 90 feet above the level of Barker creek; in the first 100 feet back from the edge, the surface of the bedrock slopes upward about 6 feet; for the next 140 feet back, bedrock is in a general way about level, but exhibits a slight channel-like depression; back of this the bedrock rises rather abruptly. The geological formations exposed consist mainly of hornblende gneiss which passes in places into hornblende schist. Some mica schist, and also some massive intrusive amphibolite also occur. The overlying gravel is in most places from 3 to 6 feet in thickness, but at certain points is as thick as 10 feet. The pebbles and boulders consist dominantly of the hornblende gneiss and other related schistose and gneissoid rocks, but amphibolite, limestone, dolomite, pegmatite, and granitic individuals also occur. The gravels are typical stream deposits of average texture, very large boulders being of rare occurrence. The main gold-bearing gravels appear to be mainly confined to a width of 100 to 150 feet, and the gold they contain is not very evenly distributed. The gravel deposits are overlain nearly everywhere by a layer of muck which is prevailingly quite thin, being only a few inches thick in places. Farther from the creek, and as the valley wall is approached, the muck gradually increases, and is known to be as much as 10 feet thick in places.

The owner of this property proposes to continue operations as soon as funds can be obtained for further equipment, and to install another ditch to supply more water. Plenty of water is believed to be available from Barker creek, and might be obtained by a ditch approximately 1½ miles long, that could be constructed at a cost of about $1,000. For continuing the working of these bench deposits downstream toward Dixie creek, a ditch could be installed that would not only take water from Barker creek but would pick up the successive tributaries crossed that join Barker from the left; thus sufficient water for hydraulicking these bench gravels would be obtained at a very moderate cost. Dr. Graham estimates that, with the additional water from Barker creek, the bench gravels on his property in the vicinity of his hydraulic cut can be mined for 5 cents per square foot, and that their gold content has so far averaged between 20 and 30 cents per square foot. The writer investigated this question of the relative cost of working and of the gold contained in the gravels, and his conclusions agree quite closely with Dr. Graham's figures. These bench deposits, being so shallow, can, with proper equipment, no doubt be mined for very close to 5 cents per square foot, and in no case should the cost of working exceed 10 cents.

Wherever the bench deposits along Barker creek have been investigated they have been found to contain for a certain width, generally 100 to 150 feet, an average of 20 cents or more per square foot. Thus this bench which extends for several miles almost unbroken along the left wall of the creek, apparently offers considerable inducements to placer mining operators, and should yield an important amount of gold in the near future.

Thistle Creek.[1]

General Description. Thistle creek follows a general westerly course, and joins Yukon river on its right side or limit, about 20 miles above the mouth of the Stewart, or 10 miles above the mouth of White river. The main valley of Thistle creek has a length of 18 or 19 miles, and, as is characteristic of the stream valleys in this vicinity, is flat-bottomed in its lower stretches, the flats varying in width from 150 to 400 yards, but toward the head it narrows into a V-shaped gulch (Plates III, IV). The grade of the valley increases gradually toward the head of the creek, being about 50 feet to the mile, 6 miles from the Yukon, and 100 feet to the mile, at about 12 miles.

Thistle creek was "discovered" by Murdock McIver and Robert Haddow, who located the upper half and lower half respectively of Discovery claim on September 28, 1898, and since this time there has been each year, more or less mining along this stream. When visited by the writer, thirteen men were actually engaged in placer mining along the creek; in addition, a few who live there most of the time had gone over to Kirkman creek temporarily. It is not definitely known why the creek was given its name by the discoverers, but their decidedly Scotch names suggest a probable explanation.

Bedrock where exposed along Thistle creek, is dominantly mica schist and mica gneiss; but other associated schistose and gneissoid rocks such as characterize this area, also occur in places. The pebbles and boulders composing the gravels along the creek are thus dominantly flat or tabular in form and consist for the greater part of these schistose and gneissoid rocks. The creek gravels are shallow, being rarely over 10 feet, and in places are only 3 or 4 feet in thickness. These are overlain, except along the creek channel, by a thin layer of muck. The depth of the muck increases toward the valley walls, and ranges in thickness from a few inches to 6 or 8 feet. On the benches, the gravels, where explored, range in thickness from 2 to 15 feet, and are overlain by a layer of muck and ice, which is as much as 60 feet or even more in thickness. An interesting feature in connexion with the bench deposits is the abundance of vertebrate remains which they include. Wherever the bench gravels along this stream have been mined or explored, the bones of mammoth, bison, and other pre-historic animals have occurred very plentifully, and are found just underneath the muck, and at the top of the gravels.

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[1] McConnell, R. G., "Thistle creek," Geol. Surv., Can., Ann. Rept., vol. XIV, 1901, pp. 31A, 32A.

The main terrace along Thistle creek is quite well defined as far upstream as Blueberry creek, but above this point it becomes gradually more indefinite. Below Blueberry creek this terrace lies for the greater part on the left or south side of the valley, but just above the creek it crosses over and thence upstream remains for the greater part on the north side of the valley. Along Thistle creek the terrace nowhere follows one side or other of the valley as persistently and as uninterruptedly as on Barker, or even along portions of Scroggie creek. This is owing to the fact that the present stream in sinking its channel down through the former floor, did not adhere for any long distances to either side of the valley but meandered frequently from side to side, and thus remnants of this old valley floor are left as terrace fragments on both sides of the present creek bed (Plates IV, V). Thus a large part of the main bench along Thistle creek has been destroyed, and the gold-bearing stream gravels it originally supported have been to quite an extent dropped down and reconcentrated by the present stream. This has greatly enriched the creek gravels, but renders the remaining portions of the benches less satisfactory to mine owing to their interrupted character.

Both the creek and bench gravels have been worked in places below Blueberry creek which joins Thistle creek about 7 miles from its mouth. Above Blueberry creek, however, the bench deposits are not known to have been explored, and the creek gravels have been only slightly prospected or mined at a few points mainly near the head of the creek. The creek gravels, where they have been mined, have been worked almost entirely by the drifting method; while the bench deposits are hydraulicked. The gold is in most places coarse and high grade, its assays comparing favourably with those of the gold from adjoining creeks. In all it is estimated that Thistle creek has yielded about $125,000 in placer gold, but certain old-time authorities claim the total production to be nearer $175,000. In any case, this has been the most productive of the four creeks considered in this memoir.

Mining Operations. The lowest property on Thistle creek, on which work was being performed, is known as the Saucerman group, which embraces twenty-nine placer claims including about 3 miles along Thistle creek, as well as six claims on Statuette creek. About the year 1907, the original owner, a man by the name of Saucerman, installed on this property a small ditch which takes water from Statuette creek. This water, although having an efficient head, is only sufficient in amount to supply one monitor part of the time. With this he operated three or four seasons. A larger ditch was, however, completed in 1912 which is about 3 miles long and takes water from Thistle creek on claim No. 5 below Discovery. This ditch was used only part of the season, when the works were closed down, and the property was not again worked until recently when a half interest was purchased from the owner, J. E. Lilk and Co., by three partners, Lawrence Fox, Kenneth Lyford, and Marian Edmunson, who operated throughout the entire season of 1915, the previous season having been devoted to prospecting with the idea of purchasing. The holdings of the owners, in addition to the claims and ditches, include commodious buildings, as well as monitors, piping, and other articles comprising quite an extensive hydraulic plant. The entire installation is estimated to have originally cost about $40,000.

The main workings are situated on the left bench of the stream, just below the mouth of Statuette creek (Plate III). There the bedrock exposed on the bench is 50 to 60 feet above the level of the creek. The overlying gravel is about 12 feet thick, and is in turn overlain by a layer of muck and ice, which is as much as 60 feet thick and even more farther back from the creek. The width of the pay gravel is unknown. It has been worked for a width ot 250 to 300 feet and the gold still persists, but back of this, the thickness of overburden becomes so great as to very greatly increase the cost of mining. During the season of 1915 about 30,000 square feet of bedrock was cleaned from which approximately $5,000 was obtained, the bedrock averaging about 17 cents per square foot.

On No. 15 [illegible] Discovery,[1] three partners were engaged in drifting, using the customary windlass for hoisting, and steam points for thawing the gravels. The water for sluicing purposes was obtained by a ditch about 800 feet long, which tapped Thistle creek higher upstream. The depth to bedrock in the shaft used is 20 feet, the upper 6 or 7 feet being in muck. In working this claim the owners are believed to have been getting gold sufficient to cover expenses, as well generally as to amount to small wages. The workings on No. 15 are typical of the various drifting operations along Thistle creek, not only as to equipment and methods of working, but also as concerns the gold yield.

Just above No. 15, Michael Okosh was hydraulicking on the left limit of the creek at the mouth of Edas gulch, on claim No. 1 Edas. At that point bedrock is 38 to 40 feet above the level of Thistle creek, and is overlain by about 3 feet of gravel, overlying which is a layer of muck and ice in places as much as 40 feet thick. The water for hydraulicking is brought by a ditch 1½ miles long, which takes its supply from Edas gulch, and delivers the water to the workings with a head of about

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[1] Discovery claim on Thistle creek is about 6 miles above the mouth of the stream.

65 feet. Due to an insufficient supply of water, a dam is used to collec and conserve it, and thus allow of its being intermittently used wheneve a sufficient amount has accumulated. Scattered gold has been founc to occur over the bench for a width of about 300 feet. The actual outlay in connexion with mining the gravels on this property, according tc a careful estimate prepared by the owner, amounts to 5 cents per square foot of bedrock, but the total expenses, including current wages to the workers in addition to living and equipment costs, amount to about 10 cents per square foot. Some years ago Messrs. Dayton and Sons are reported to have taken $25,000 from claim No. 1, Edas gulch, this amount of gold being obtained from gravels close to the edge of the bench.

On Discovery claim, also on the bench along the left limit of Thistle creek, Thos. H. Barton was engaged in hydraulicking. Mr. Barton was holding fifteen placer claims on Thistle creek, most of which he had held for seven years. He has installed a ditch 2 miles in length, with a capacity of 1,000 inches, which takes water from Blueberry creek. Where he was working, the gravel was about 15 feet thick, and was overlain by 30 to 35 feet of muck and ice. Mr. Barton was working entirely alone, using a large sized monitor. During the summers of 1914 and 1915, he claims to have moved over 300,000 cubic yards of material, but has altogether uncovered only a small amount of bedrock, and has consequently not recovered much gold--his work having been so far to a great extent expended on installation.

On No. 8 above Discovery, Lawry Nikow was engaged in drifting, using a one-man self-dumping equipment for hoisting, and steam points for thawing the gravel. He has been on this ground since 1906, working mainly in winter. The depth to bedrock in his shaft is 17 feet, the upper 6 or 7 feet being muck, and the rest gravel. The ground in this vicinity is in most places frozen to bedrock throughout the entire year, except along the creek channel where there is no insulating covering of moss and muck; there the gravels are thawed not only during the summer, but in places remain unfrozen near bedrock during the winter as well. Gold in paying quantities, according to this method of working, has, on claim No. 8, been found scattered irregularly over a width of at least 250 feet. Mr. Nikow states that his ground has averaged at least 55 cents per square foot of bedrock.

Above No. 9 above Discovery, with the exception of a claim or so, all the rest of the creek, when visited, was vacant, and very little work even of a prospecting nature had been performed. Some representation has been done, however, and a few small dumps have been taken out. The work that has been performed has been practically all drifting, as it is considered that, especially near the head of the creek, open-cutting is not practicable owing to the fact that the stream is subject to sudden floods from rain or melting snow, which are liable to wash out any surface installation. Undoubtedly the creek gravels all along this upper portion of the stream can be profitably mined almost to the head of the valley, even by the present methods employed.

On No. 160 above Discovery, one man, James Fitzgerald, was engaged in drifting. Along that part of the creek, bedrock is 6 to 12 feet deep, the overlying deposits being about half muck and half gravel. The gravels that will pay to work by the drifting methods at present employed, are as a rule from 20 to 25 feet wide, but in places are as much as 60 feet. The creek deposits there are generally sufficiently frozen for drifting, from about November 15 to April 15, and along the sides of the valley they can be worked throughout practically the entire year. Working with windlass and wood fires, the average man will mine 1,000 square feet or perhaps more during the winter, and will obtain at least $400 from his spring clean-up.

Kirkman Creek.

General Description. Kirkman is the smallest of the four creeks considered in this memoir, its main valley being only 11 or 12 miles in length. It follows a general westerly course and joins the Yukon about 8 miles above the mouth of Thistle creek, or 28 miles above Stewart post-office, near the mouth of Stewart river.

Kirkman creek is named after Grant Kirkman who located the upper half of Discovery claim on October 13, 1898, following which, the creek was stampeded and staked. From that time until 1914, prospecting was carried on from time to time, but very little actual mining was done. The total amount of gold mined from Kirkman creek previous to 1914, according to an estimate furnished by the gold commissioner of Yukon Territory, probably did not exceed $2,000. In April, 1914, Joseph C. Britton and William Haas made a new discovery, and staked a Discovery claim about one mile below the canyon, or 3½ to 4 miles from Yukon river. This caused the creek to be again stampeded and staked, and since that time there has been considerable prospecting and mining along the stream. During the winter of 1914–15, there were about forty men on the creek, and during the past summer (1915) an average of thirty men were there engaged in placer mining.

The rocks exposed along Kirkman creek are dominantly mica schists, but include also certain of the other old schistose and gneissoid types characteristic of the district. The pebbles and boulders comprising the gravels are dominantly flat or tabular in form, and are composed of the mica schists and other related schistose and gneissoid rocks.

The main terrace on Kirkman creek, instead of persisting up to the head of the valley, in similar fashion to the terraces on the other creeks here being considered, continues upstream from the Yukon a distance of only about 5 miles, to a point at the lower edge of the canyon. There the surface of the terrace, and the present valley bottom meet and coalesce (Plate VI). That the terrace does not extend farther upstream, as along the other creeks, is mainly owing to the smaller size of the creek, and its consequent less eroding power. The stream has thus been able to sink its new channel down through the old valley bottom only as far upstream as the so-called canyon which is really not a canyon, but is merely a somewhat constricted portion of the stream channel, and represents the main working face of the creek, in the process of extending its newly deepened channel upstream. The canyon is thus still steadily advancing up the valley, and, as it does so, remnants of the valley bottom are left on either side of the stream channel in the form of benches or terraces. Another reason, although apparently a minor one, why Kirkman creek has not been able to sink its channel in the old valley bottom farther upstream, is that the rejuvenation has been less along this stream than on Thistle creek, and possibly also than along Barker and Scroggie creeks. This is evidenced by the fact that the elevation above the river of the main terrace along the right limit of the Yukon, becomes gradually less upstream from Stewart river, and the main terraces on Thistle and Kirkman are tributaries of this terrace. Thus the elevation above the Yukon of the terrace at the mouth of Kirkman creek is less than at the mouth of Thistle creek, and the added eroding power due to the increased head originally causing the terraces, is also less.

The bench gravels are still practically unexplored except for a small amount of work done by Alex. McDonald about 1907, and very little information concerning them is thus available. The creek gravels below the canyon have also been only very slightly prospected, the development work that has been done being almost entirely restricted to the 2 miles of creek bottom immediately above the canyon. Where the deposits in the creek bottom have been explored, the depth to bedrock in most places along the central portion of the valley is from 15 to 20 feet; nearer the edges of the valley bottom the thickness of the superficial deposits increases to 35 or 40 feet. The creek deposits, excepting those under the present creek channel, are nearly everywhere frozen to bedrock during the entire year. The cost of drifting the creek gravels along Kirkman creek by the hand methods at present mainly employed, *i.e.*, where steam plants are used for thawing and the gravels are hoisted by windlass, amounts to about 50 cents per square foot of bedrock—this including current wages to men, fuel, and equipment costs. With larger and more efficient outfits, including steam-operated, self-dumping equipments, this cost could be considerably reduced.

The gold in the creek bottom above the canyon is fairly uniformly distributed along certain definite channels, where the mining and prospecting operations to date would indicate that the gravels have an average gold content of from 50 cents to $1 per square foot. The type of bedrock, however, controls the distribution to quite an extent. The hard, dark, mica schist which is so extensively developed along Kirkman creek, is well adapted to retaining the gold, whereas soft, slippery rocks with smooth flat surfaces allow the gold to be carried over much more readily. An assay of the gold from claim No. 49 above Discovery, which is typical of the creek in general, ran $17.92 in gold and 6 cents in silver. The total gold yield from Kirkman creek up to October, 1915, is estimated to be about $10,000, including about $2,000 previous to April, 1914.

Mining Operations. The lowest point along Kirkman creek at which any mining was being done, when visited, was on claim No. 40 above Discovery. The depth to bedrock, there, ranges from about 9 to 13 feet, and the gold content of the gravels was found to average about $1 per square foot of bedrock, for a width of 20 feet, but neither edge of the pay had yet been encountered. On No. 42 above Discovery, the owner stated that the pay gravels were at least 100 feet in width, and contained gold to the extent of $10 per point—each point thawing 12 to 15 square feet of ground. The depth to bedrock is about 19 feet near the creek, and as much as 25 to 30 feet nearer the edges of the valley flat. The gravel that had been mined, contained gold amounting to about $10 per 6-foot point—each point thawing 12 to 15 square feet of ground.

LODE DEPOSITS.

Quartz veins occur at a number of points in the vicinity of these creeks, but only one deposit is known to have been discovered which shows any promising amount of mineralization, or has been at all developed. This vein occurs on the Black Fox mineral claim which is owned by Frederick B. Kennedy, and is located about 2 miles south of Thistle creek on the north side of Blueberry creek near its head, the elevation of the vein outcrop being about 1,850 feet above the mouth of Blueberry creek. The vein was definitely exposed only in a pit or open-cut 8 or 10 feet in depth, which represents the total development on it. From this comparatively slight exposure, the vein appears to strike north 17 degrees east (magnetic), and to dip to the northwest at about 30 degrees. It occurs in a fissure in a medium textured, greyish, mica gneiss and has an average thickness in the cut of about 3 feet. The vein is composed dominantly of quartz which carries more or less galena, chalcopyrite (copper pyrites), pyrite, and malachite (green copper stain).

These ore minerals are, however, very localized in their occurrence, som portions of the vein being quite well mineralized, while other portion are apparently quite barren. The finding here of even a limited amoun of promising ore material, however, should stimulate lode prospectin in this vicinity.

SUMMARY AND CONCLUSIONS.

Important placer deposits occur along Scroggie, Barker, Thistle, and Kirkman creeks, and lode deposits have been found in their vicinity. The known lode deposits are of relatively little importance, none having been discovered that would appear to be of present economic value, though it is quite possible in a district as well mineralized as this area is known to be, that deposits of value may yet be found.

Gravels carrying gold in important amounts occur in the valley bottoms of all these streams. Also, extending along the sides of these valleys, there occur benches or terraces the tops of which represent former, higher positions of the creeks. These benches support stream gravels that, wherever they have been explored, have been found to be gold-bearing to an economically important extent. In fact the gold in the creek gravels, except along the upper portion of Kirkman creek, would appear to be largely a reconcentrate from the bench deposits, which accounts for its somewhat sparse and erratic distribution in most places. The bench gravels are practically unexplored along Scroggie and Kirkman creeks, and have been prospected or mined at a few points only, along Thistle and Barker creeks. They thus present a very promising field to placer mining operators. The creek gravels, although developed to a greater extent than the bench deposits, have also been tested at only a comparatively few points. It is believed that they can be mined at a profit along the greater part of the creek bottom even by the somewhat crude, hand methods now employed; and that they would yield greater profits if worked in a more comprehensive and efficient manner. The future of these creeks, and the area in which they occur, however, depends largely on the development of the bench deposits.

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PLATE V

Graham's bench workings on the left side of Barker creek, near the head of the stream. Bedrock on this bench is 85 to 90 feet above the level of the creek opposite. The view shows the nearly flat character of the bedrock, and the shallowness of the gravels, which are from 3 to 6 feet thick in most places. From the cut shown, which is nearly 500 feet long by 100 feet wide, $10,000 in gold is believed to have been obtained.

PLATE III.

The hydraulic workings on the Saucerman property on the left bench of Thistle creek. Bedrock, which is here 50 to 60 feet above the creek opposite, is overlain by about 12 feet of gravel above which is 50 to 60 feet of muck and ice as shown in the high cut bank in the right of the view.

PLATE IV.

Looking down the valley of Thistle creek from the workings on the Saucerman property, toward the Yukon which lies just in front of the mountains shown in the background. The view shows the irregular character of the main bench, this being partly on the right and partly on the left of the present creek.

Plate V.

Looking upstream from the workings on the Saucerman property on Thistle creek. The somewhat irregular character of the main bench or terrace is shown, this being partly on the right and partly on the left side of the present stream. The V-shaped character of the valley, also the gently rounded, grass and moss clad land features characteristic of the district are depicted. Also the sparse character of the forest growth of this general locality is shown.

PLATE VI.

Looking down Kirkman creek from a short distance below the canyon. The pronounced terrace or bench on the right side of the creek is well shown and a corresponding terrace remnant may be seen to the left. The typical V-shaped character of the valley with its verdure clad slopes is also shown.

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PUBLICATIONS OF THE GEOLOGICAL SURVEY.

The Geological Survey was established in 1842 and "Reports of Progress" were issued, generally in annual volumes, from that date to 1885, the first report being that for the year 1843 published in 1845. Beginning with the year 1885, "Annual Reports" (new series) were published in volumes until 1905, the last being Vol. XVI, 1904. Many of the individual reports and maps published before 1905 were issued separately and from 1905 to the present, all have been published as separates and no annual volume has been issued. Since 1910, the reports have been issued as Memoirs and Museum Bulletins, each subdivided into series thus:—

Memoir 41, *Geological Series 38.*
Memoir 54, *Biological Series 2.*
Museum Bulletin 5, *Geological Series 21.*
Museum Bulletin 6, *Anthropological Series 3.*

In addition to the publications specified above, a Summary Report is issued annually; and miscellaneous publications of various kinds including Reports of Explorations, Guide Books, etc., have been issued from time to time.

Publications Issued Since 1909.

MEMOIRS.

Memoir 1. *Geological Series 1.* Geology of the Nipigon basin, Ontario, 1910—by Alfred W. G. Wilson.

Memoir 2. *Geological Series 2.* Geology and ore deposits of Hedley mining district, British Columbia, 1910—by Charles Camsell.

Memoir 3. *Geological Series 3.* Palæoniscid fishes from the Albert shales of New Brunswick, 1910—by Lawrence M. Lambe.

Memoir 4. *Geological Series 7.* Geological reconnaissance along the line of the National Transcontinental railway in western Quebec, 1911—by W. J. Wilson.

Memoir 5. *Geological Series 4.* Preliminary memoir on the Lewes and Nordenskiöld Rivers coal district, Yukon Territory, 1910—by D. D. Cairnes.

Memoir 6. *Geological Series 5.* Geology of the Haliburton and Bancroft areas, Province of Ontario, 1910—by Frank D. Adams and Alfred E. Barlow.

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A reconnaissance across the Mackenzie mountains on the Pelly, Ross, and Gravel rivers, Yukon and North West Territories, 1910—by Joseph Keele.

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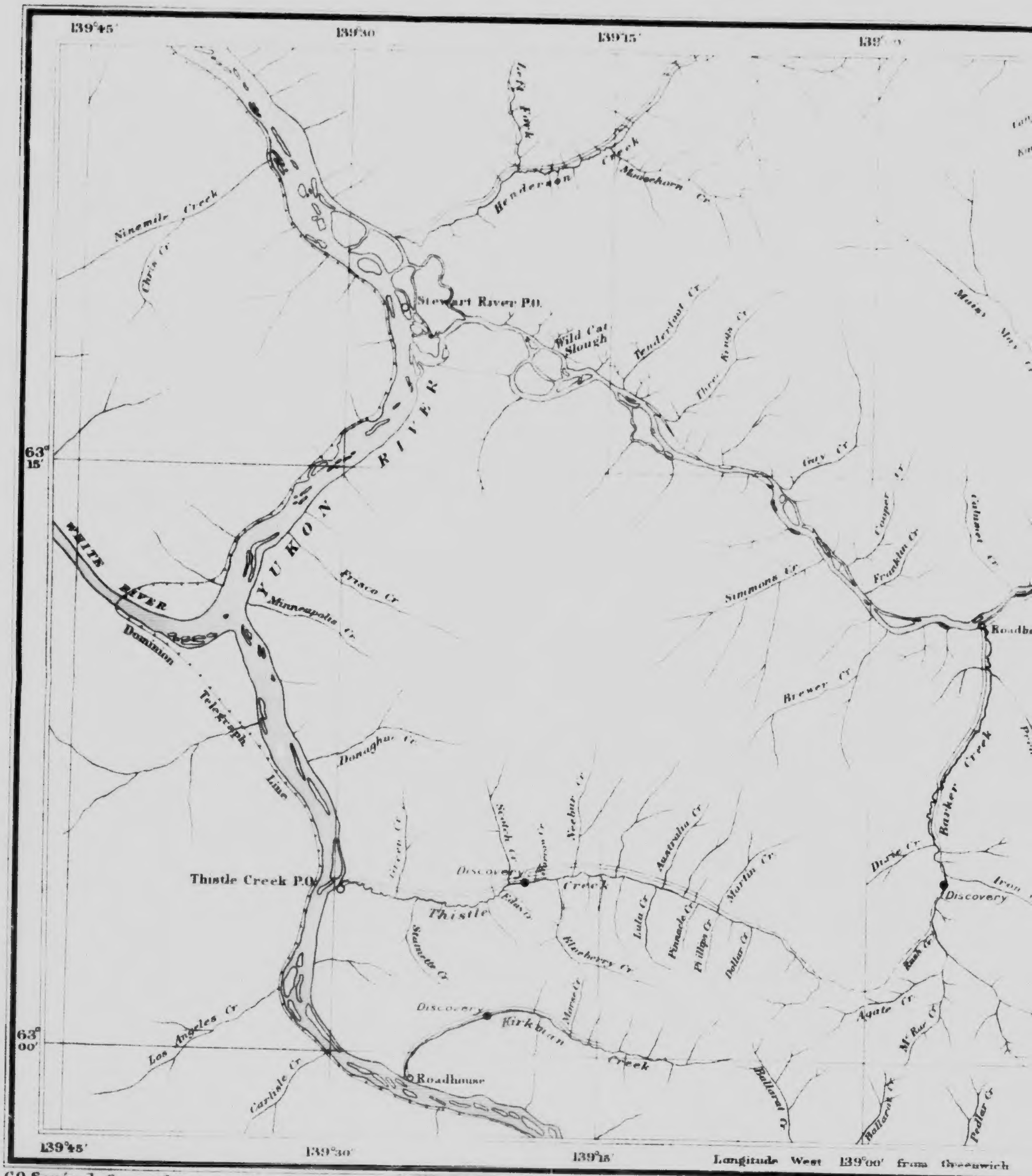

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(Issued 1916

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To accompany Memoir by D.D. Cairnes.

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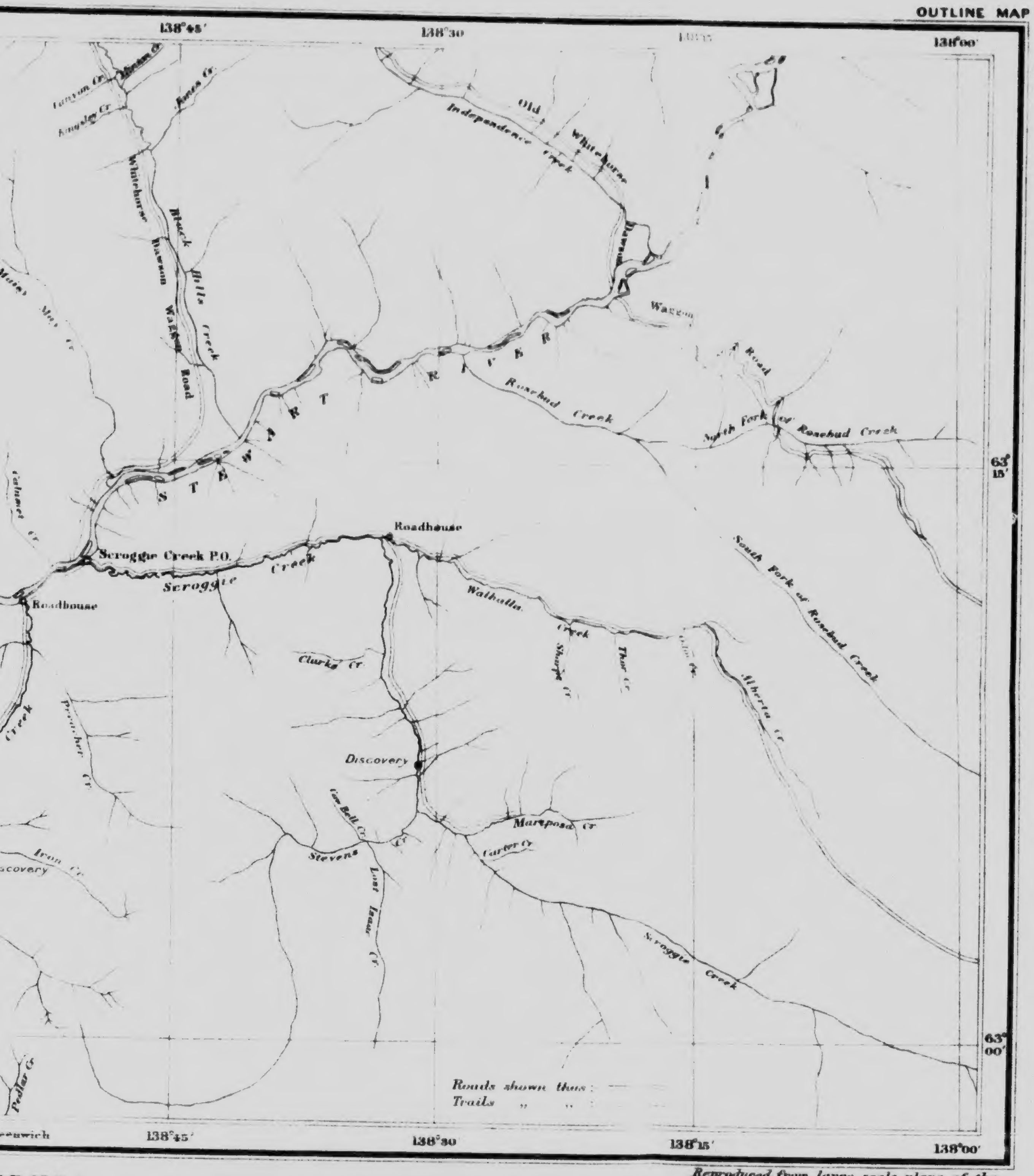

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